Thin-film SiC Encapsulation for Neural Prostheses

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Challenge/Problem:

Dielectrics used in semiconductor devices, Si_3N_4 and SiO_2, corrode or exhibit poor H_2O and ion barrier properties. The challenge is to develop alternative dielectrics that provide long-term *in vivo* stability while remaining compatible with established semi-conductor processing methods.

Progress:

Amorphous SiC was found biocompatible by histology of neural tissue adjacent to a-SiC coated metal shafts in cortex. Corrosion rates of a-SiC were 20 times lower than Si_3N_4 at 90^{o}C in saline and not measurable at 37^{o}C. Leakage currents of $<10^{-11}$ A/cm^2 are achieved with a-SiC and a-SiOC at a ±5 V bias.

Approach:

Thin films of amorphous silicon carbide (a-SiC) and amorphous silicon oxycarbide (a-SiOC), deposited at 100-350^{o}C by plasma enhanced chemical vapor deposition (PECVD), are investigated as implantable dielectrics. Biocompatibility and long-term *in vitro* stability are assessed by histology, corrosion rate, and leakage current measurements.

Current/Near Term Products:

Amorphous SiC and a-SiOC coating services are provided to researchers and companies developing neuroprosthetic and other implantable devices. Coatings of a-SiC/a-SiOC with exceptional stability and encapsulating properties are patented by EIC Laboratories (U.S. 5,755,759) and available for licensing.

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Future Plans:

To evaluate a-SiC coatings on flexible, polymer substrates and to conduct long-term pulsing studies of charge-injection electrodes on metallized a-SiC films. To develop a reactive ion etching process for photolithographic patterning of a-SiC and a-SiOC thin films.

Keywords: dielectric; corrosion, electrode, PECVD; silicon carbide